

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Submission of Proposals

The responsibility for carrying out DARPA's SBIR Program rests with the Technology Assessment and Long Range Planning Office. The DARPA Coordinator for SBIR is John K. Meson.

DARPA invites the small business community to send proposals directly to DARPA under the following address:

DARPA/TALRPO  
Attention: John K. Meson  
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Arlington, VA 22209-2308

The proposals will be processed in the Technology Assessment and Long Range Planning Office and distributed to appropriate technical offices for evaluation and action.

DARPA has identified 33 technical topics to which small businesses may respond. A brief description of each topic is included below. The topics originate from DARPA technical offices.

SB87-001      TITLE: Advanced Short Takeoff/Vertical Landing Aircraft (ASTOVL) Technology

DESCRIPTION: Recent technological advances in high thrust to weight engines, composites aircraft structures, computer integration of flight/propulsion controls, and computation fluid dynamics have indicated that various concepts for ASTOVL aircraft may be feasible in the next decade. Several common technologies to all ASTOVL concepts need further investigation e.g., hot gas reingestion (computer modeling scaling laws, nozzle geometry); Fan Air Collection, valves, ducting (design code development, turning and mixing losses, low loss duct flow, etc); Thrust Augmentation by burning (low loss, compact burner technology) Jet Plume/Aircraft Structure interaction (analytical prediction of jet plume trajectories, definition of thermal environment, Thermal/Acoustic fatigue testing of lightweight materials); Ground Erosion (code development on jet impingement and surface erosion mechanics, surface material treatments); Integration of Flight/Propulsion controls (determine impacts on system design, innovative architecture/redundancy).

SB87-002      TITLE: Low Observable Technology for Infrared Suppression on Aircraft

DESCRIPTION: A technology base is required for advanced design that will allow the suppression of infrared signatures that contribute to aircraft detection or missile guidance against the aircraft. Techniques to cool propulsion system or airframe parts, coatings to reduce emissivity or to deflect aircraft radiance, or techniques to modify plume signatures as required.

SB87-003      TITLE: RPV Technology

DESCRIPTION: Increased demands will be made on RPVs to achieve combination of higher altitude, longer endurance, greater payload capacity, higher velocity and increases in survivability. These drivers require extending the state of the art in the areas of structures, propulsion, control surfaces, reliability, weight reduction and the development of analytical and experimental techniques to evaluate potential improvements configured for a hostile natural environment. Methods need to be developed for the design and evaluation of low Reynolds number airfoils to achieve high performance small RPVs To reduce drag induced by turbulent boundary layers, techniques are needed to evaluate concepts that suppress the turbulent mixing process in the boundary layer such as riblets, large eddy breakup device, etc. To achieve high maneuverability, control surfaces must be developed to achieve maximum lift increments in a minimum time without inducing stall. Stall reduction techniques will be a necessary compliment to any implementation. The understanding of turbulence induced loads needs to be extended through a combination of a vehicle aeroelastic model with an atmospheric model that develops the turbulent. Longer endurance leads to the need for improved reliability particularly in electronic components and for an increased on-board positional accuracy determination. A requirement exists to develop an inertial reference unit (IRU) whose design achieves high reliability through some combination of component improvement redundancy, and result tolerance and management.

SB87-004      TITLE: Interactive Radar Cross Section Calculations

DESCRIPTION: Currently, few if any efforts have been directed towards the development of interactive three dimensional (3D) Radar Cross Section (RCS) calculations. Implementation of interactive color graphic algorithms on a personal computer would enable the user to model the 3D cross section he desired to evaluate. The personal computer can then output the data to a larger mainframe for RCS evaluation, and return the data to the personal computer Cathode Ray Tube (CRT) for evaluation or change. The use of color graphics will allow the user to represent materials with differing electromagnetic properties. It is desired that more dramatic and user-friendly graphics be provided so that a user can simulate a time domain pulse strike, penetrate, and propagate around a scatterer. Evaluation of a creeping wave around a damper-coated cylinder would be of particular interest. The interactive computation and display of bistatic RCS presented in a frequency domain plot or a 3D polar plot with radius corresponding to frequency versus azimuth would be of significant value to the RCS analysts.

SB87-005      TITLE: National Aero-Space Plane Technology Innovations

DESCRIPTION: The National Aerospace Plane (NASP) program incorporate major technological advances in: high temperature, high strength, oxidation, resistant, reusable materials; cryogenic fluid management; advanced turbulence and boundary layer transition modeling; ramjet/sramjet propulsion; active leading edge, nose and structural cooling and advanced high temperature instrumentation. This research task will address any of the areas with innovative new design ideas suitable for eventual incorporation in a flight research vehicle. A first phase program of design, analysis and proof of concept experimentation should be described with sufficient concept descriptions to enable comparison with other approaches. The second phase would involve large scale test and analysis.

SB87-006      TITLE: Advanced Wind Tunnel Measurement Techniques

DESCRIPTION: The area of aerodynamic wind tunnel has not experienced new and novel measurement techniques for years. Forces are measured through conventional measurements systems, air pressures are measured with either rakes or numerous slot/sensor holes in the vehicle, and temperature needs to be measured by sensors placed on or near the vehicle of interest. It is the thrust of this study to identify new and novel non-intrusive measurement wind tunnels. The primary area of interest is in the subsonic to transonic region. Approaches that allow the dynamic measurement of the various parameters identified will be considered.

SB87-007      TITLE: Advanced Radar Cross Section Measurement Analysis

DESCRIPTION: Current measurement techniques for Radar Cross Section (RCS) provide a large amount of data about the target that isn't being used. Traditional techniques of looking at amplitude as a function of position can give the analyst the relative data but does nothing to identify the sources of the reflections. Various imaging approaches to help identify these "Hot Spots" have been implemented with varying degree of success. We are interested in new approaches and algorithms that can be used to assist the analyst in data assessment. Concepts that use Artificial Intelligence or Rule Base ExpertSystems are one of the areas that would be strongly considered. New concepts that can extract RCS information in more timely manners without adding significantly more RF equipment would be considered. It is not anticipated that a radar range is needed to investigate/develop the approaches. Data will be made available by the Agency.

SB87-008      TITLE: Remote Detection of Nuclear Material

DESCRIPTION: New ways are sought for monitoring the presence of nuclear weapons on the battlefield from a distance of at least several hundred meters. Traditional detection measurement schemes use "in situ" scintillation and ionization devices to detect primary, energetic products of radioactive decay of various nuclear materials. Direct detection using this kind of nuclear instrumentation has generally been unsatisfactory in the past due in part to the attenuating effects of the atmosphere at significant range.

Innovative methods are sought for detection using laser or microwave radiation as a means of remotely probing direct or induced radioactivity. Proposals must be based on the exploitation of sound basic physical concepts. Successful schemes must lead to devices which are portable and rugged and ideally be capable of differentiating among various elements and isotopes within an ambient background.

SB87-009      TITLE: Compact Accelerator Concepts

DESCRIPTION: The size and weight the current state of the art in the production and acceleration of very high current, relativistic electron beams is several orders of magnitude beyond what could be reasonably employed in a commercial or tactical military environment. New techniques for handling such beams, such as ion-focused guiding and branched-magnetic switching, have been recently developed within the Department of Defense and are believed to offer great potential application to this problem.

Innovative ideas are sought which would lead to the eventual development of electron beam accelerators capable of delivering high quality beams of between 10-100 kiloamperes accelerated at gradients of greater than 20 Mega-electron Volts (MeV) per meter to a total of several hundred MeV energy. Total weights less than several hundred tons are desired. Pulses are required at rates of 10-40 kHz in burst of 10-20 pulses each of which is 100 nanoseconds in length. Efficient injection, transport, and extraction are other crucial requirement. The offeror should demonstrate his/her innovative concept through analysis, design, and a limited demonstration.

SB87-010      TITLE: In-Processing Sensor Concepts for Intelligent Processing of Materials

DESCRIPTION: DoD has increasingly stringent materials requirements in order to achieve many of its future systems concepts. These advanced materials will need to be processed, utilizing revolutionary concepts for process control which involved direct, in-situ, real time monitoring of the evolution of intrinsic features of the materials such as microstructure, phase change, defect formation, etc. DARPA has interest in research aimed at such sensors for processes including in bulk crystal growth of especially gallium arsenide and for critical steps in the production of advanced carbon-carbon composites. Proposals should address the rationale concerning which aspects of the process are key to successful, reproducible manufacture of such materials and how the specific sensor research proposed addresses the need.

SB87-011      TITLE: Electro-Optic Techniques for Very Large Scale Integrated Interconnect (VLSI)

DESCRIPTION: A major limitation to achieving significantly speed increases in VLSI lies in the metallic interconnects. They are costly, not only from the charge transport standpoint, but also from capacitive loading effects. The Department of Defense, in pursuit of the fifth generation super computer, will be investigating alternatives to the VLSI metallic interconnects, especially the use of optical techniques to transport the formation, either inter-or intrachip. Interests include such areas as source and detector integration onto a VLSI chip, the optical control of integrated electronic devices, optical switching elements, reconfigurable optical channels, and all-optical generalized cross-bar switching networks.

Guided channels may be considered for intrachip interconnect, but the advantages of unguided optical channels should play a major role in solving interchip and interprocessor communications. Once the electronic signals have been converted to optical signals, optical imaging and holography may be used to guide the optical beam to its destination which would likely be a photo-detector to another chip. One may go so far as to envision reprogrammable interconnects employing the optical phenomena of four-wave mixing. The bottom line in realizing opto-electronic interconnects is a need optics that lies at the root of many of the desired operations – form integrated light source, through optical switched and reconfigurable channels, to four wave mixing. Consideration will be given to proposed studies into nonlinear optical materials, new device concepts, optical/electronic integration schemes, and interconnect architectures.

SB87-012      TITLE: Application of Adaptive Neural Networks

DESCRIPTION: New approaches and concepts are sought to develop and apply novel computational methods associated with physiological models. Such methods might utilize models of human neurons and networks of neurons to deal with complex problems such as learning and planning. These networks of neuron model are often found to be adaptive to their environments, and respond to external changes by altering their input gains according to some functional relationship.

The goal is to apply these new techniques to problems associated with tactical air warfare avionics, such as trajectory determination, pattern recognitions, and adaptive threat response. Adaption of computational approaches to utilize new ideas and hardware and software developments in parallel computing architectures is anticipated.

SB87-013      TITLE: Cement Paste Matrix Composite Materials

DESCRIPTION: The DoD has interest in inorganic materials which can be processed under ambient conditions to form structural components processing mechanical properties far superior to the currently available commercial concretes. In general, hydrated compounds of calcia, alumina and silica such as found in ordinary portland cement are known to react with water at room temperature to form the cement paste found in concrete. Research envisioned in this areawill examine the relationship between the phases present in the microstructure and mechanical properties, i.e., strength, stiffness, toughness and durability. Portland cement chemistry may be used as a baseline for these studies but investigations of other cement paste systems are also encouraged. Particular emphasis should be given to determining principles by which this class of materials can be toughened and made much more durable than is possible using current technological practice. It is also of interest to examine the potential of tailored composite microstructures on which such cement pastes are used as the matrix material. The interaction of the cement paste matrix materials with carefully controlled dispersed phases of various chemical compositions and morphologies will undoubtedly produce composites with a broadrange of mechanical properties. The goal of this research is to reveal the potential of this new class of materials with a low-cost, easily processed alternative.

SB87-014      TITLE: Instrumentation for Semiconductor Material And Device Characterization

DESCRIPTION: Electrical characterization of devices often proves to be the most sensitive measurement for indicating problems in starting materials of processing techniques. Instrumentation is needed that can relate the electrical determination programs proposed in this area should focus on either Gallium-Arsenide, Mercury Cadmium Telluride or electro-optic materials, and should clearly establish the methodology for relating the electrical or optical properties to the physical measurements. Emphasis is on new techniques which will provide new monolayer resolution in at least one physical dimension, or submicron resolution in two dimensions.

SB87-015      TITLE: Characterization of Millimeter-wave Devices

DESCRIPTION: Solid state device technology is achieving structures that hold promise for achieving useable power gain in the Mw-wave region. Techniques for direct measurement of gain as well as for the complete parametric characterization of such devices are needed. Proposed techniques should be capable of at frequency measurement to at least 100 gigahertz.

SB87-016      TITLE: Analysis of Thermal and Shock Reduction of Composite Mechanical Properties

DESCRIPTION: Directed energy weapons cause ablation and impulse loading when incident on a surface, which translates into thermal and shock effects interior to the material. Generally will be composites in conventional two-dimensional layups; flate plate geometry may be taken. Analysis is needed to describe the mechanical properties of the medium during and after irradiation by the directed energy beam, particularly when subjected to in-flight aerodynamic loads. Simplified techniques and results are especially required, with appropriate accuracy, to serve for sensitivity analysis of materials parameters and for trial compositions in combined (thermal/shock) hardened structures development.

SB87-017      TITLE: Speech Understanding Using High Level Knowledge

DESCRIPTION: Speech recognition research is reaching the point of accuracy and performance where speech recognition and higher level natural language can be effectively combined. Proposals are requested for the development of techniques to allow for the processing of common speech dialogue that is both imprecise and errorful from a strict grammatical sense. Of interest are effective ways to utilize the power of high level language processing methods to aid in speech recognition. This is to include the processing of prosodic information such as stress or inflection to enable machines to interpret and understand the meaning of spoken input.

SB87-018      TITLE: Combining Database and Artificial Intelligence

DESCRIPTION: Knowledge-based Systems have been successfully utilized in the rapid prototype development of complex military systems. In many cases these prototype systems have emphasized the need for techniques to integrate knowledge-based processing with methods for managing large amounts of data and knowledge. Proposals are requested for the development of methods for both loose and tight integrations of these technologies. Included is the incorporation of more powerful techniques within data management modules to allow reasoning about special classes of data. Included also are techniques for efficiently storing large amounts of knowledge in various levels of abstraction to be used in a shared user environment to support advanced reasoning processes.

SB87-019      TITLE: Auditory Modeling for Speech Recognition

DESCRIPTION: Advances in speech recognition have indicated the potential effectiveness of auditory models for front-end speech recognition analysis. Proposals are requested for developing and demonstrating that model the human hearing process and extract features from a speech signal which can effectively be used by higher level processing agents for speech recognition and understanding.

SB87-020      TITLE: Secure Remote Electronic Switch

DESCRIPTION: A capability is sought to provide a front-line unit commander with the ability to alter the status of multiple munitions using a coded signal transmission device. An example of the use of this device would be to turn a mine field on or off. The system should be highly reliable, jam resistant, low cost, and so on. The system should be highly reliable, jam resistant, low cost, and should provide acknowledgement of the status change. In addition, it should be extremely difficult to break the code, even after listening to the previous transmission or after capture of the receiving and/or transmitting unit.

SB87-021      TITLE: Photon Echo Memories and Computers

DESCRIPTION: The quantum mechanical interaction of laser light with electronic states in certain cryogenically cooled crystals can lead to the phenomenon of the photon echo, in which re-emission of the photon occurs after a known delay time. Theory indicates that the delay can be long (compatible with Random Access Memory refresh modes in conventional computers). Computational indicates storage capacity of 10<sup>15</sup> bits per cubic centimeter and access times in the sub-picosecond range. This task calls for laboratory experiments to demonstrate read write memories of 16 bits or higher in three years. Applications include high density storage for real-time processing in high performance imaging systems; and high speed computing for target classification and identification. Work should include demonstration of feasible access concepts and refresh modes.

SB87-022      TITLE: Magnetic Imaging Seeker

DESCRIPTION: Most military targets of interest contain large amounts of magnetic materials. Conventional seeker technology for negating tanks, artillery and other similar weapons relies on exploitation of optical, millimeter wave and infrared signatures for detection of target in clutter. These seekers concepts require sophisticated electro-optical imaging concepts that degrade in high clutter and certain combinations of target and weather conditions. This Research Task will investigate the feasibility of magnetic imaging concepts as replace mentor adjunct to conventional tactical seekers. The investigator will recognize and isolate tactical targets in clutter at various ranges out to a few kilometers. These arrays should be capable of eventual packaging in small auxiliary sensors, strapdown operation, accuracy, influence of the earth's magnetic field and the effects of simple countermeasures. If necessary the investigator will recommend development of miniature magnetometers with properties compatible with the requirements derived during the initial study phase. The second phase of the program will proceed either to the development of a test array or to testing of development magnetometers. Proposals must contain analysis indicating preliminary feasibility assessment.

SB87-023      TITLE: High Power Density Components for Electromagnetic Launchers

DESCRIPTION: Electromagnetic launchers are being considered for a variety of missions including anti-aircraft, armor and ballistic missile defense. Innovative concepts are needed in a variety of technologies relating to the repetitive operation of such devices as practical weapon systems. Acceleration concepts that mitigate or eliminate high current opening switches are needed. High power density electrical power supplies and pulse forming networks are desired to minimize the total system weight. Techniques for reducing and rejecting the waste heat generated in switches, rails, inductors and other components are desired for both ground and space based systems. Innovative launcher concepts for applying electrical energy to achieving high projectile velocities with high efficiency are particularly sought.

SB87-024      TITLE: Special Materials for High Current Switches

DESCRIPTION: Electrical pulsed power devices are being developed for a variety of weapons applications. Power conditioning circuits for these very high power devices require non-linear circuit elements which exhibit large changes in electrical conductivity.

Solid materials which have reversible phase changes with associated conductivity changes of three or more orders of magnitude would have many applications. Such materials would desirably be capable of dealing with applications. Such materials would desirably be capable of dealing with current densities as high as 1000 amperes/sq. cm. In their conductive state.

There are available a very limited number of materials which undergo reversible phase changes near ambient temperatures and which have the desired electrical properties. Experimental efforts which would identify and characterize new materials would be of interest to DARPA.

SB87-025      TITLE: Standoff Detector for Mines and Explosive Devices

DESCRIPTION: A capability is desired to enable dismounted troops, armored vehicles, and/or aircraft to detect the presence of explosive filled ordnance, especially mines, at ranges of military interest. As an estimate, these ranges extend from 10 to 100 meters for dismounted troops, 50 to 500 meters for armored vehicle, and 250 to 2500 meters for aircraft. In all cases, maximum range is desired. Characteristics of mines include the following. The mines may be on the surface or buried up to one foot underground. They may have metal or plastic cases. They will generally contain high explosives. They will vary from approximately 1 to 10 kilograms. They may have pressure, anti-disturbance, magnetic, seismic, or combination fuses.

Concepts which address only a portion of the desired capability will be considered if their military value can be shown.

SB87-026      TITLE: Instrumentation to Measure the Characteristics of Currents At and Near the Ocean's Surface

DESCRIPTION: We require the development of instrumentation to measure precisely currents and current gradients at near the surface of the ocean. Ideally, the instrumentation should be capable of measuring from the surface to one meter depth, in increments of one millimeter, and in all three dimensions. One centimeter increments is an acceptable minimum capability. Ideally, the instrumentation should have a velocity resolution of one millimeter per second accurately measure velocity gradients down to at least one meter depth, and measure strain rates of 1026 per second.

It is preferred that the system be non-contact, reasonably portable, and easily set up by trained personnel

Concepts which approach or meet only certain of the above requirements will be considered if their value can be shown .

SB87-027      TITLE: Synthetic Aperture Radar Image Processing Studies

DESCRIPTION: Proposals are sought dealing with the processing of Synthetic Aperture Radar (SAR) images. New ideas and concepts are desired for speeding up the processing time required to form a SAR image. Such processing essentially involves performing a two-dimensional convolution on coherent radar data consisting of the target range and target Doppler. Specific ideas are sought in any or all of the following areas.

- a) use of phase information derived from coherent radar return signal
- b) application of parallel processor architectures for SAR image formation
- c) ability to process data in polar coordinates
- d) use of frequency diversity techniques for SAR image formation

The contractor must have computer facilities for doing such processing as described above and should be able to process the radar ocean monitoring satellite (SEASAT) data as a minimum.

SB87-028      TITLE: Synthetic Aperture Radar Image Enhancement Studies

DESCRIPTION: Proposals are sought for image enhancement techniques and algorithms for Synthetic Aperture Radar (SAR) images. The contractor should be able to work with standard image pixel format data tapes and must demonstrate a capability in image analysis and manipulation. Existing image processing equipment is essential for any potential offeror. Algorithms and pattern recognition schemes are sought for the detection of weak surface signals in ocean clutter. Techniques should examine random position orientation of the signal and should investigate the impact of non-Rayleigh background statistics. The offeror should be able to work with images derived from the radar ocean monitoring satellite (SEASAT) experiments. The ability to generate simulated images for the expected range of signals and clutter conditions would be a valuable asset.

SB87-029      TITLE: Military Application of Artificial Oxygen-Converting "Gill"

DESCRIPTION: An unclassified technology being developed for DARPA by the Aquanautics Corporation in San Francisco promises a future capability to remove efficiently dissolved oxygen from seawater. System concepts which may be enabled by the technologies need to be enumerated and evaluated. Some applications that might be considered include underwater power and propulsion, swimmer delivery vehicles, medical oxygen for submarines, and remote site industrial oxygen generation.

The work requested should include an enumeration of concepts, a feasibility study of the more promising ones, and a development plan for recommend applications.

SB87-030      TITLE: Video Arcade Level Training Devices

DESCRIPTION: New ideas are sought for the use of video arcade level technology in low cost training devices for military combat skills. Areas of interest include but are not limited to new graphics concepts, computer generated realistic opponents, and networked devices. The target costs for production versions of such devices is 10,000 and below.

SB87-031      TITLE: Simulator for individual Infantry Soldiers

DESCRIPTION: Ideas are sought for creating simulation environments for individual infantry soldiers performing combat skills as members of small teams. Current simulator technology is well-suited for combat vehicles (e.g., flight simulators for fighter aircraft), but simulators for an individual. Ideas on how to create such simulator for an individual moving on the ground, assuming combat positions, and engaging opponents, has proven technically difficult. Ideas on how to create such simulations leading to prototype construction, are sought.

SB87-032      TITLE: Special Effects for Simulators

DESCRIPTION: Simulators involve the use of illusory technology to create realistic environments for the operators, e.g. sights and sounds of the battlefield. Ideas are sought on ways to employ new techniques in special effects technology to increase the realism of simulators. Promising applications will likely be tested in prototype simulators. Promising applications will likely be tested in prototype simulators for evaluation.

SB87-033      TITLE: Digital Data Base Construction for Computer Image Generation

DESCRIPTION: Advances in networked microprocessor work stations allow new methods for digitizing cartographic, topological, pictorial, and feature data for use in digital data bases feeding computer image generation graphic computers. New ideas are sought for the application of this type of technology to database construction, particularly techniques which will allow the rapid construction of high detail databases. Ideas can be theoretical as well as application and machine specific.